MANUFACTURING

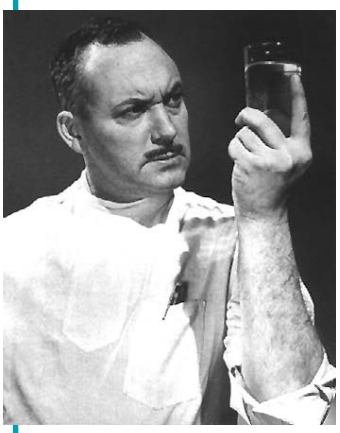
The Right Chemistry

A look at chemicals and how people use them

EDUCATIONAL IN NATURE®

What is Chemistry?

Look all around you – at the chalkboard, your desk, your hand. Look out the window at the trees and the clouds in the sky. What do all these things have in common? They are all examples of matter. In fact, everything you can think of is matter – including the air you breathe.



Chemistry is the study of matter – what it's made of, the changes that take place in it, and how it reacts and combines to create new chemicals.

When you think about chemical reactions, you probably have visions of scientists working in a lab and chemicals bubbling in test tubes. However, chemical reactions go on around you every day! When you mix the ingredients for a cake – like milk, flour, sugar and eggs – and bake them in the oven, you've combined chemicals to create something that's completely different (and tastes better!) than what you started with.

By studying chemistry and the chemical reactions of different types of matter, we can create chemicals and products that improve our lives.

CHEMICALS FROM TREES

What do glue, salad dressing, chewing gum, plastic, ice cream, detergents and your rayon shirt have in common?

They all contain chemicals that come from trees! Trees are a natural supply of valuable chemicals and are the basic ingredients used to make many of the things we consider necessary in everyday life.

WHERE DO TREE CHEMICALS COME FROM?

Chemicals such as turpentine and rosin are stored in the sticky sap of trees.

Cellulose is the wood fiber. It is often combined with other chemicals and used in products such as ice cream, baby food and shampoo.

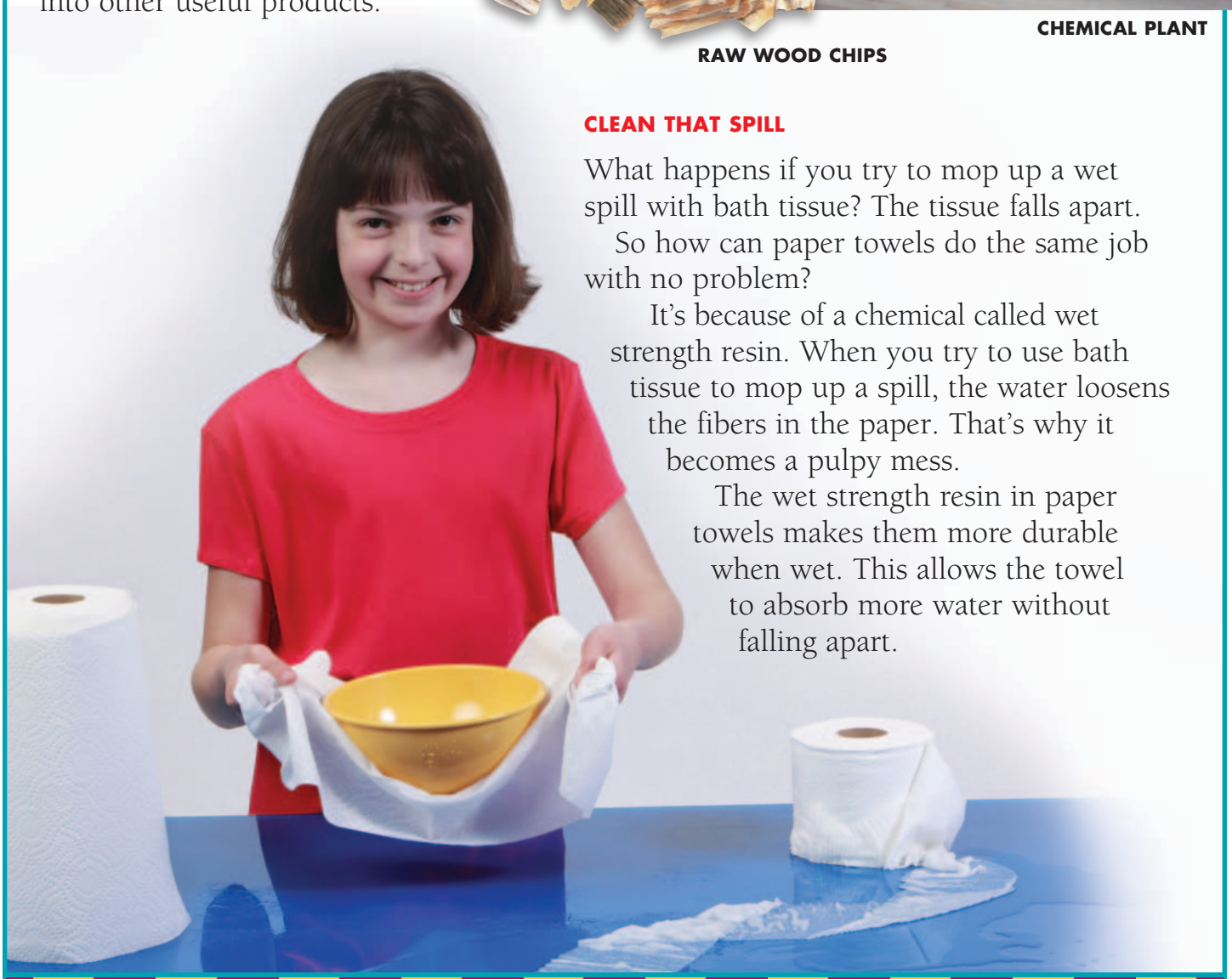
Lignin is another chemical we get from trees. It is a glue-like substance that holds the tree's cellulose fibers together.

These chemicals can be removed from the tree during the process that turns wood chips into paper.

They are then sent to a chemical manufacturing plant, where they are made into other useful products.

RAW WOOD CHIPS

CHEMICAL PLANT



CLEAN THAT SPILL

What happens if you try to mop up a wet spill with bath tissue? The tissue falls apart.

So how can paper towels do the same job with no problem?

It's because of a chemical called wet strength resin. When you try to use bath tissue to mop up a spill, the water loosens the fibers in the paper. That's why it becomes a pulpy mess.

The wet strength resin in paper towels makes them more durable when wet. This allows the towel to absorb more water without falling apart.

Sticky Things

Building products like plywood, oriented strand board and particleboard are used to make everything from houses to furniture. These engineered panel products are lighter and thinner than solid wood, but can be just as strong. How is that possible? Because of chemistry.

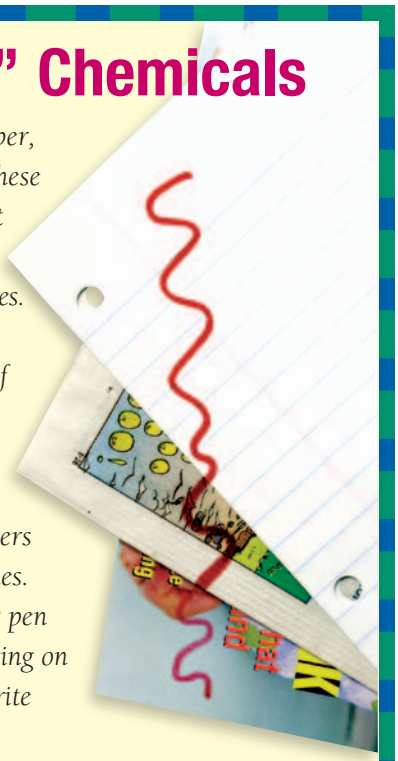
WOOD CHIPS ARE VISIBLE IN ORIENTED STRAND BOARD

Engineered panels are made of wood veneer or wood chips and shavings held together by special glues called resins. These resins contain polymers, which are long, winding chains of small molecules. Polymers are everywhere – the hair on your head is a polymer.

When a resin is applied to wood fiber, its polymers keep the glue from being absorbed completely into the wood. This enables the resin to form a strong bond, under heat and pressure, between layers of veneer or wood chips and shavings. Because the bond is formed inside the wood fiber as well as on the surface, we get products that are strong enough to build a house!

PLYWOOD IN NEW HOME CONSTRUCTION

The "Write" Chemicals



Paper towels, newspaper, writing paper – all these papers have different characteristics that make them useful for different purposes. How does that happen?

Fiber from different types of trees is used to make different kinds of paper products. But chemicals added during the papermaking process give papers many of their distinct properties.

Try writing with a marking pen on a newspaper. Now try writing on a glossy magazine. Finally, write something on notebook paper.

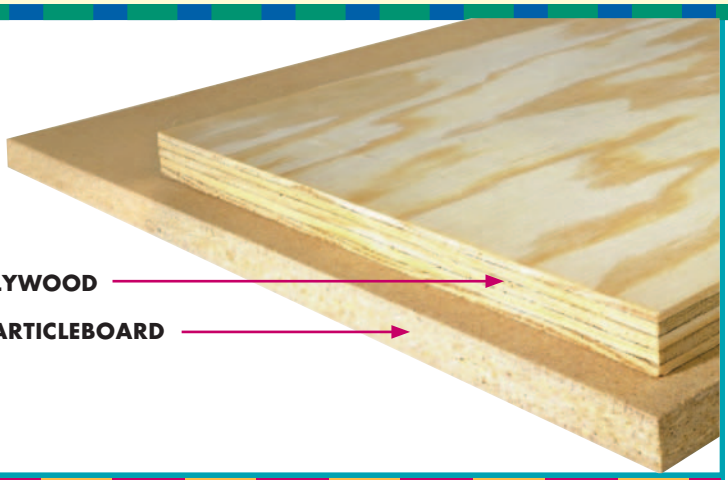
What happened to the ink? On the newspaper, it spreads and makes your writing blurry. On the glossy magazine, the ink probably didn't even stay on the paper – it rubbed right off. On the notebook paper, your letters were sharp, and the ink stayed on the paper.

A chemical called size, which is added to the paper, makes the difference.

Newspaper has no size added, so the paper absorbs the ink like a sponge absorbs water. That's why it spreads.

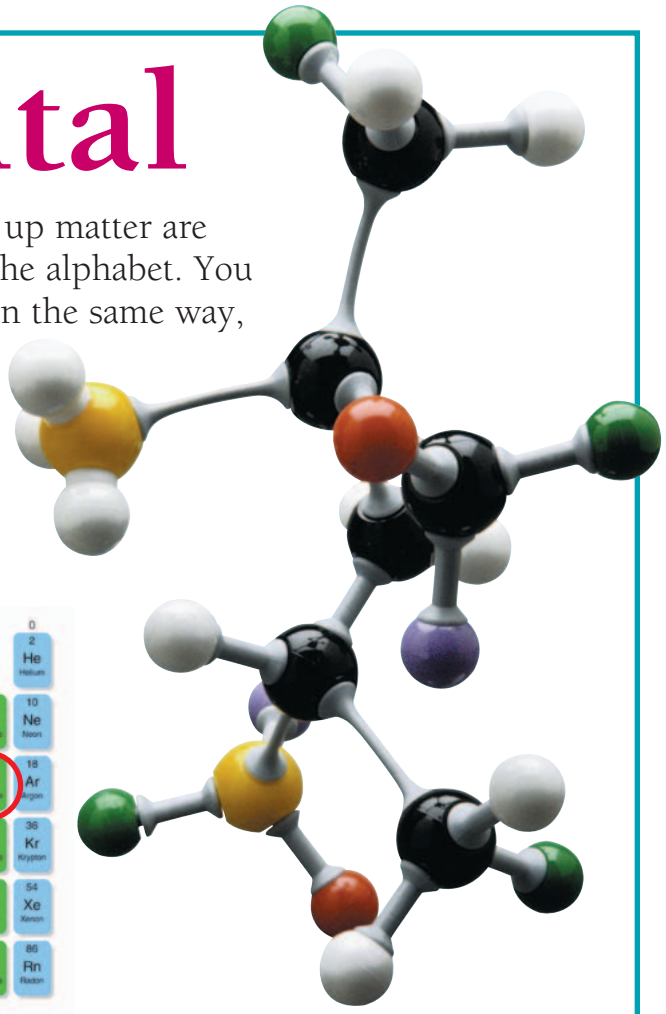
A glossy magazine is coated with a chemical that repels water, just like wax on a car, so the paper doesn't absorb the ink from your pen at all.

The paper in your notebook has a chemical coating that allows the paper to absorb enough ink so it doesn't wipe right off. It also keeps enough of the ink on the surface of the paper so that it doesn't bleed, and the letters stay sharp and clear.



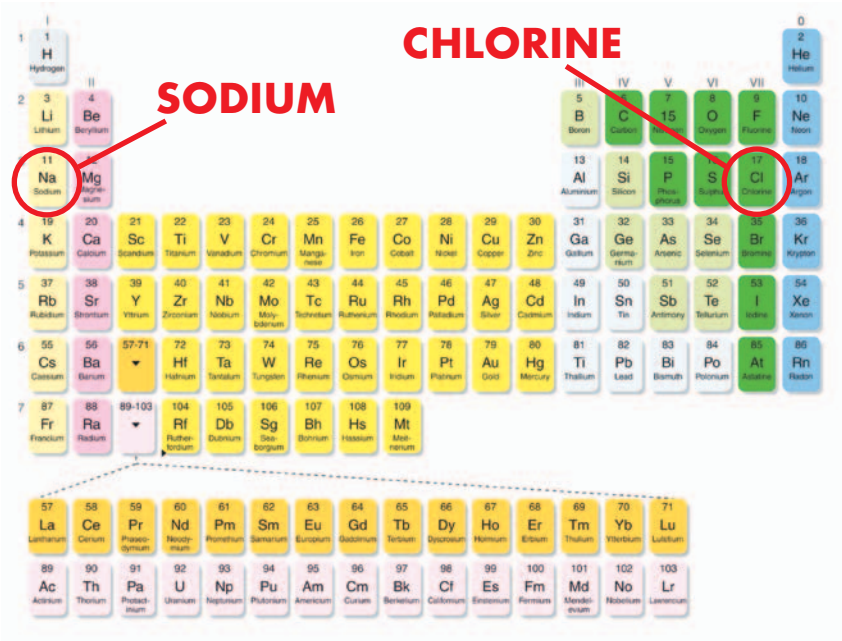
It's Elemental

The basic substances or chemicals that make up matter are called elements. Think about the letters in the alphabet. You could not write any words without letters. In the same way, you cannot make anything without elements.



CHEMICAL BUILDING BLOCKS

The Periodic Table shows all the chemical elements that scientists have discovered so far. There are over 100! All the millions of substances found on earth are made up of different combinations of these elements.



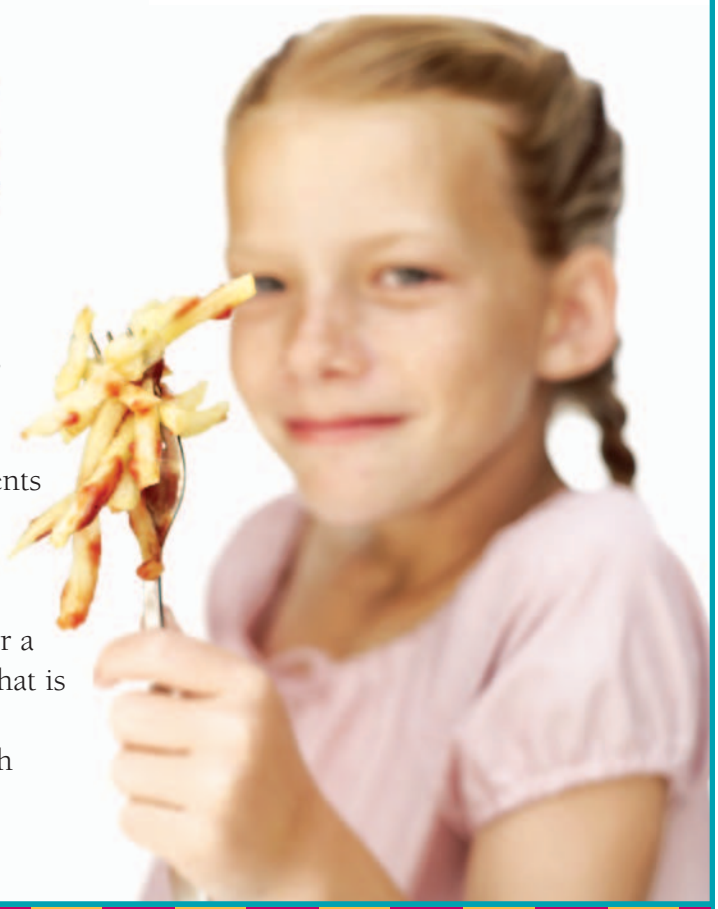
What a reaction!

Can you imagine putting two unappetizing elements together and then sprinkling them on your french fries? That's ridiculous, isn't it? Well … maybe not.

Sodium and chlorine are both unappetizing elements on their own. But when they react with each other, they create an entirely new chemical – table salt!

How does this happen? A chemical reaction takes place that joins the two elements together. Whenever a chemical reaction occurs, a new substance is made that is different from the original materials.

To make a new substance, atoms combine through a chemical connection called a bond.



The Right Chemistry

ACTIVITIES & Extras

Still think that chemistry is boring? Try these experiments to see for yourself just how fun chemistry can be!

WHAT YOU NEED:

- Teaspoon
- Large jar
- Large mixing bowl
- Measuring cup
- Safety glasses
- 4-ounce bottle of white all-purpose glue such as Elmer's® Glue-All® multi-purpose glue (not school glue)
- 1½ cups (360 ml) distilled water
- Food coloring (optional)
- Borax powder

OOOOOOOZING SLIME

WHAT TO DO:

1. Pour the glue into the jar. Add four ounces (120 ml) of distilled water to the glue. Mix well.
2. Add 2 to 5 drops of food coloring to the glue solution. Mix well.
3. Pour one cup (240 ml) of warm distilled water into the bowl and add 1 teaspoon of borax powder. Mix well.
4. Slowly add the glue mixture to the bowl containing the borax mixture, stirring as you do so.
5. Knead the thick slime with your hands. (You may want to wear rubber or plastic gloves to do this!) The slime will be wet, stringy and messy at first, but the more you play with it, the firmer it becomes.
6. Slime will dry out when exposed to air for a long time. To preserve it, store your slime in a self-sealing bag in the refrigerator.

WHAT HAPPENED?

How does this oozing mass of slime hold together? The glue molecules are polymers. When you knead the mixture, the borax joins these polymers together into even longer polymer chains. That's why the slime becomes so thick – the more polymer chains that are formed, the thicker the slime becomes.

WORDS TO KNOW

atom – the smallest part of an element

bond – special chemical connection between atoms of the same or different elements

cellulose – complex fibers inside plants

compound – something made up of two or more elements. Compounds are held together by chemical bonds

lignin – a glue-like substance that holds the tree's cellulose fibers together

oriented strand board – panel made from strands of wood layered at right angles and glued together with resin

particleboard – panel made from wood chips or shavings mixed with resin

plywood – panel made of thin sheets of wood that are glued together

resin – a substance from the gum or sap of trees

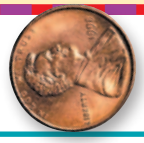
size – chemical that helps paper repel moisture and water-based inks

veneer – thin sheets of wood

Magic Pennies

WHAT YOU NEED:

- Jar
- Measuring cup
- Safety glasses
- ½ cup (120ml) white distilled vinegar
- Pinch of salt
- 10 – 20 copper pennies
- 1 iron nail
- Scouring powder



WHAT TO DO:

1. Pour vinegar into the jar. Add the salt.
2. Put the copper pennies into the vinegar. Let them sit in the vinegar for at least five minutes.
3. Clean the nail thoroughly with scouring powder. Rinse the nail, making sure all the scouring powder is removed.
4. Drop the nail into the vinegar with the pennies. Let it sit for about 15 minutes.

WHAT DO YOU SEE NOW?

The nail is coated with copper. And the pennies are bright and clean.

WHAT HAPPENED?

When the vinegar mixed with the salt, which is made of sodium and chlorine, a chemical reaction occurred that loosened the bonds holding the sodium and chlorine together. The loose chlorine molecules cleaned the pennies.

The copper molecules from the pennies combined with the molecules in the vinegar to make a new molecule – copper acetate. The copper acetate then coated the nail!